

WHAT IS CLAIMED IS:

1. A method of manufacturing an optical element,
comprising the stages of:

machining a substrate;

5 removing a contamination from a surface of the
substrate after the machining; and

removing a deterioration layer in the surface of
the substrate after the machining.

10 2. A method according to claim 1, wherein the
substrate is made of CaF₂ single crystal.

15 3. A method according to claim 1, wherein the
contamination removing stage includes the stage of
focusing laser light on the surface of the substrate.

4. A method according to claim 3, wherein the
laser light is KrF excimer laser light.

20 5. A method according to claim 1, wherein the
deterioration layer removing stage includes a step of
ultrasonic-washing the surface of the substrate with an
aqueous wash solution.

25 6. A method according to claim 5, wherein in the
ultrasonic washing step, ultrasonic washing with a wash
solution containing a surface-active agent and

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ultrasonic washing with pure water are performed in succession.

7. A method according to claim 6, wherein the
5 deterioration layer removing stage further includes a step of rinsing the substrate with pure water and a step of drying the rinsed substrate after the surface of the substrate is ultrasonic-washed with pure water.

10 8. A method according to claim 1, wherein the contamination removing stage includes the steps of:
immersing the substrate in acetone;
taking out the substrate from the acetone and then wiping the surface thereof with a paper containing
15 diamond powder;
processing the wiped surface of the substrate with solvent; and
processing the surface-processed substrate with UV/O3.

20 9. A method according to claim 8, wherein the solvent is ether.

25 10. A method according to claim 6, wherein the surface-active agent is an alkalescent surface-active agent.

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11. A method according to claim 7, wherein the drying step is performed with a warm air.

12. A method according to claim 1, wherein the
5 machining stage includes a step of cutting the substrate from a CaF₂ single crystalline base substrate and polishing the surface of the cut substrate with a predetermined surface shape.

10 13. A method according to claim 12, wherein the machining stage includes a step of forming a protective film on the polished surface of the substrate, and the contamination removing stage is performed after the protective film is removed from the surface of the
15 substrate.

14. A method according to claim 1, wherein the contamination is one of abrasive, oil content, and other foreign matter.

20 15. A method according to claim 1, wherein a surface roughness of the optical element is 0.5 to 0.55 nm by an examination with an RMS.

25 16. A method according to claim 1, wherein the optical element is one of a lens, a prism, a transparent plate, and a transparent rod.

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17. A method of manufacturing an optical element,
comprising the steps of:
machining a substrate; and
removing a deterioration layer in the surface of
5 the substrate after the machining.

18. An exposure apparatus comprising:
an optical system having an optical element
manufactured by the manufacturing method according to
10 any one of claims 1 to 17, for illuminating a wafer
with laser light having a wavelength of 200 nm or less.

19. A device manufacturing method comprising the
stages of: exposing the wafer by the exposure
15 apparatus according to claim 18; and developing the
exposed wafer.

20. An optical element washing machine including
an optical element holding unit, an excimer laser unit,
and a focal control unit for focusing excimer laser
light from the excimer laser unit, the optical element
holding unit having a holder, a rotation stage, and a
three dimensional control stage,
25 in which the holder is means for holding an
optical element,
the rotation stage is means for rotating the
holder,

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the three dimensional control stage is a
constitution element of position control means for
causing the rotation stage to move in a vertical
direction and/or a horizontal direction,

- 5 the excimer laser unit is a light source for
emitting ultraviolet radiation, and

 the focal control unit has basic control value
setting means for setting a basic control value for a
focal matching state of the ultraviolet radiation from
10 the excimer laser unit, focal matching determination
means for determining a focal matching state of the
excimer laser light, and correction means for sending a
correction amount corresponding to a determination
result of the focal matching determination means to the
15 position control means.

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